

## Accelerator Systems Division Highlights for the Two Weeks Ending July 11, 2003

### ASD/LANL: Warm Linac

#### HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) We received three tuning posts from E2V for the DTL klystron, and installed the 75 mm post. The 96-hour heat run at full SNS conditions is underway. The factory acceptance tests for DTL klystron S/N 11 have been rescheduled to September because of a vacuum leak that is thought to be due to arcing damage on the gun ceramic. The next tube scheduled to be tested at E2V is S/N 5 in mid August. (2) We received SCL klystrons S/N 23, 24, and 25 from CPI. Tests for S/N 26 are in progress. S/N 27 and 28 are being prepared for tests, and 29 and 30 are being assembled. (3) We shipped two fully conditioned and tested DTL windows to ORNL. S/Ns 8 and 1(rebuilt) will begin the bake out once we regenerate the cryopump.

Concerns & Actions: Are primary concern continues to be the performance and timely delivery of the Thales klystrons: (1) We are prepared to test CCL klystron S/N 5 on 7/16 at Thales, S/N 3 on 7/18, and S/N 1 on 7/24. If successful, we will be able to maintain schedule. (2) Thales representatives visiting LANL extended their trip to troubleshoot the SCL klystrons until 7/10. Tube S/N 1 did not meet the power or efficiency requirements and S/N 2 did not meet efficiency requirements.

#### HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) The last 140-kV high-voltage converter modulator (for the HEBT klystrons) was factory accepted. The unit is forecast to ship to ORNL next week. (2) The first SC Linac HVCM was factory acceptance tested, and it operated at 78 kV and 128 A for 8 hours without incident. This operating condition corresponds to eleven 550-kW klystrons running at 11.2 A each and 75 kV with a 4% margin. These numbers are consistent with measurements at LANL on the CPI klystrons for the required output RF power. The unit is forecast to ship to ORNL next week. (3) We modeled and re-confirmed SCL HVCM start pulse parameters for present DSP control algorithm. We also modeled start pulse parameters for an upgraded DSP control algorithm with improved algorithm to reduce IGBT start currents (major concern for 60 Hz operation) and improve pulse rise time. (4) We are implementing an engineering change notice to Dynapower to use a higher inductance filter choke (12 mH) on the SCL HVCM; this will improve settling time by 100 microsec and improve usable pulse width by 10%, as well as reducing ripple

Concerns & Actions: (1) LANL and ORNL have resumed a weekly presence at Dynapower to support adequate QA.

#### DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: (1) We received RF drive irises for DTL Tanks 4 and 5 from CMI. They will be cleaned, tested, inspected, and then shipped to ORNL next week. (2) We accepted a prototype drift tube (1-59) and qualified another vendor for Tank-2 production. RFQs for this procurement were issued; bids were received and are being evaluated. (3) Tank-4 drift tube bodies cavity machining of groups A, B, C and D is in progress. Units and samples for proof of water channel weld repair are at Hanford and are being welded this week. (4) Tank-5 drift tubes groups E, F and G are ready for diverter-to-body brazing. (5) Tank-6 drift tube diverter brazing preparation for groups H and I is done; these units will be brazed next week. (6) A large shipment of the 304 stainless steel drift tube mount "top hat" pieces have been received at LANL for cleaning and final processing.

Concerns & Actions: (1) Steve Ellis has been assigned to work with the electromagnet dipole (EMD) coil vendor (Milhous) to solve the previously reported tolerance and fit problems of the EMDs. Ellis has contacted and conferred with Milhous was at their facility this week to work out changes/repairs. EMD inspection tooling was fabricated in Los Alamos and shipped to Milhous. Gauss meters for monitoring condition of EMD magnets during the assembly welding have been ordered. (2) A conference call was held with ESCO's management and we received a pledge from them that they will adequately staff our work in their Concord facility. They are planning on adding a manufacturing engineer and an overall project engineer. In addition, they will generate a master schedule and will monitor work relative to this schedule and will report at a standing weekly conference call with LANL.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: CCL Module-1 tuning is scheduled to begin with help from L. Young and J. Billen later this month. LANL and ORNL staff will assist during the several week period running through mid August. (2) The first castings have arrived from the stainless foundry for the magnet legs; machining to the finished surfaces and mounting holes will commence shortly as tooling is ready. (3) Mechanical inspection of the completed Module-2 support structure at General Tool was completed by M. Collier and S. Ellis. Results were satisfactory and part will

ship to ACCEL this month. General Tool was final machining the upstream half of the Module-3 parts while they were there, so progress is good on those items as well.

Concerns & Actions: We received the formal quote from ACCEL on the plug repair. ACCEL is quoting delays in module delivery. Delivery of the last (fourth) CCL module would be in March 2004, 3 months later than the Integrated Project Schedule date. LANL and ACCEL staff held a conference call this week to discuss options to accelerate this delivery.

#### **SUPERCONDUCTING LINAC WARM SECTIONS (WBS 1.4.6)**

J. Gioia was at Alpha Scientific to witness integrated acceptance testing of the first production unit SCL magnet power supply. All functionally was met. Alpha will now deliver 5 units per week starting this week.

#### **ASD/JLAB: Cold Linac**

Testing of cryomodule M-2 is complete and the unit is being prepared for shipment to ORNL.

Cryomodule M-3 has been installed in the test cave and will be cooled down next week.

M-4 is scheduled for completion by the middle of next week.

M-5 has been assembled into the vacuum vessel.

The cavity string for M-6 has been completed and will be turned over to the cryomodule assembly team next week.

#### **ASD/BNL: Ring**

Diagnostics: Spreadsheets for deliverables and spares were forwarded to ORNL earlier this month for comment. The need for ORNL's attention to Spares spreadsheet is becoming urgent, as we need to integrate spares into purchase and production schedules. Items moved to FY05 for the end game plan include IPM magnets, Beam-in-Gap kicker, and tune kicker power amplifiers.

HEBT Vacuum: All vacuum chambers have been fabricated. Drift chambers are in various stages of vacuum firing and leak checking. Fabrication of the two momentum dump pipes is complete. Design of the injection dump line has stalled due to the priority to complete drawings in support of ASD installation efforts.

Bids for the HEBT momentum collimator's Outer Shielding are being evaluated for contract award.

Engineers will travel to Ranor Inc. next week to inspect and approve the first article Outer Shield Assembly for the HEBT collimators.

Magnetic measurements of the first article 30Q44 quadrupole are complete. The field was measured using an AGS integral harmonic coil modified to measure at a larger radius. The data analysis includes the harmonic terms for 1.0 and 1.3 GeV fields and the integral field as a function of excitation current. We are awaiting feedback and approvals from the AP Group.

Design room efforts continue on the HEBT quad and dipole installation/assembly drawings in support of ASD's hardware installation efforts.

Two HEBT collimators have been shipped from SDMS to SNS/OR. ETA is Aug. 4.

The shipment of eight 21Q40 quads from Tesla to SNS/OR has been rescheduled from 7/11/03 to 8/8/03. (The deltas are getting shorter!)

Work is underway to update and expand the magnet parameter spread sheets to include measured resistance, power requirements, PS matching, heat loads and water flow.

M. Hemmer is working with ASD on the naming system and convention for all BNL supplied hardware.

R. Lambiase is working with ASD to develop a polarity spreadsheet that will define magnet orientation and polarity hook-up for all the lattice magnets.



HEBT Shielding

## Controls

## Installation

Craft Snapshot 7/9/03

ASD craft workers	74.0
Foremen, ES&H, etc	12.0
Less WBS 1.9 etc	8.0
Less absent	1.0
TOTAL	77.0

RCCS issues caused the delay of DTL #1 Conditioning on Friday, July 11, 2003. The DTL #3 RF window had been installed on DTL #1 in anticipation of RF conditioning beginning over the weekend.

The cooling water fittings on the DTL #1 window will have to be reworked due to the water leak that developed during hook up of the cooling water lines.

DTL #1 shielding installation was completed.

DTL #4 was moved to the Front End building in preparation for further assembly.

Problems continued with filters clogging quickly in the cooling water loops to the RCCS. This issue needs to be addressed with CF as it does not appear to be improving.

The second Medium Beta Cryomodule will be delivered from JLAB in a few weeks i.e., late July or early August.

JLAB personnel will be on site August 5, 2003 to stuff the first SCL vacuum rack.

C-1 Half Cell installation (PEP 2-12) did not take place this week. It is now anticipated next Tuesday July 15, 2003.

High Beta wave guide in the Klystron Hall started this week.

It has been decided to relocate HEBT dipole stands using an adapter plate approach. This rework will begin next week.

### **Accelerator Physics**

S. Kim has performed finite-element analyses of beam pulse damage in copper. This is essential information for evaluating fault scenarios and beam commissioning operations. This work extends that done earlier by Bob Shafer. He finds that thermal diffusion can play an important role for longer pulse lengths (beyond about 10 microseconds). These results are being used to evaluate fault scenarios.

The DTL1 Beam Commissioning Plan is being updated and expanded to include detailed step-by-step tasks that are planned for beam commissioning.

The applications programming group is working on online-modeling capabilities for use during commissioning. An application which provides trace-3D style modeling capabilities using "live" machine data has been produced and demonstrated.

Matlab applications for DTL1 commissioning have been produced by D. Jeon and Y. Kisselev. The applications include acceptance scan, phase scan, beam loading scan and emittance analysis.

### **Operations Group**

We are preparing for DTL Tank 1 Processing and Front End Startup

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Test Plans:

Still do not have Proposed Test Plans from Diagnostics

Most Test Plans have not been completed with Hard Copies submitted to Operations. We have:

Electrical Systems

Conventional Systems Controls

Ion Source, have some pieces but it is not completely signed off

The Shielding Plan for RF Processing of DTL 1 – sign off complete

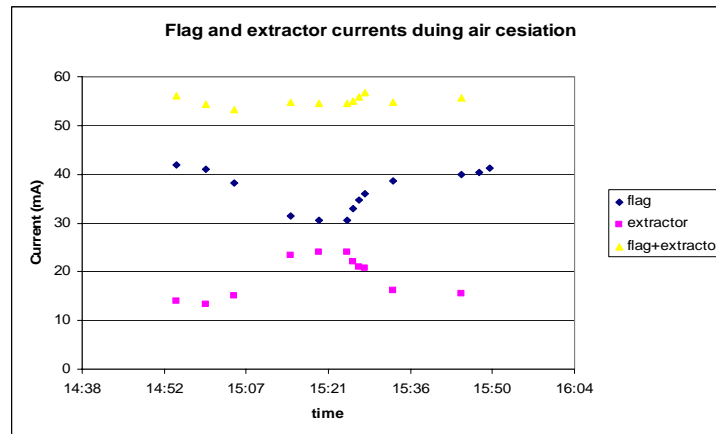
The Operational Approval for RF Processing of DTL 1 – sign off underway, must be complete to begin.

The ASD Action Tracking system is up and running

Determine the rules for submission and sign off

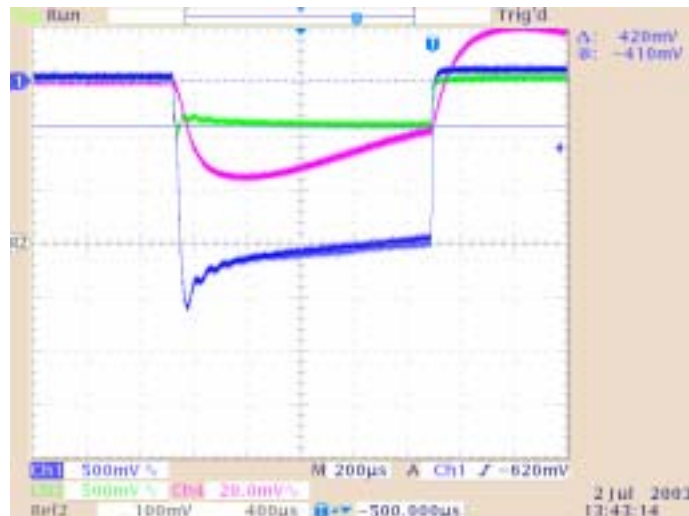
## Ion Source Group

The spare ion source on the hot spare stand has been extensively tested and tuned to maximize the H- current output. This included cesiation studies with the newly developed 600°C air heating system that allows extracting beam during the cesiation process. The observed H- output current (=flag current) decreases with increasing collar temperature while the current of the escaping electrons (= extractor current) increases. The sum of the two currents appears to remain about constant, which is interesting, but not fully understood.



The test included operations with the peak current exceeding 40 mA for 8 hours using a 0.1% duty cycle. When operated for 4 hours at a 4% duty cycle, the peak current reached 34 mA with 52 kW RF power. Later it was possible to operate the source for 4 hours at a 6% duty cycle with 38 mA with 40 kW RF power.

While the electron current (green trace) remains roughly constant, the H- current (blue trace) falls off with increasing pulse length, yielding an average current that is roughly 20% smaller. RF tuning and gas flow variations allow reducing the peak current to obtain a flatter current pulse.



## Survey and Alignment

## Mechanical Group

### Water Systems Installation

- Completed piping installation from the CF headers to the HVCM at DTL\_ME-3

- Continued piping from the CF headers to the RCCS and TRCC skids at CCL 3
- Installed additional pipe hangers in RF Test Facility.
- Completed piping installation from the CF headers to both of the TRCC skids at SCL\_ME1
- Completed chilled water piping from the CCL 3 Conventional Facilities (CF) headers to the RCCS skid.
- Completed DI piping from the RCCS skid to the waveguide tunnel.
- Met with John Kristy, Skip, and Don Vafias regarding the slow progress on CCL 3. A comparison of the SRO hours on CCL 3 versus CCL 1 & 2 indicates an installation slowdown by the Pipefitters; Don will address the issue with the fitters on Monday.
- Continued piping installation work on SCL 1.
- Continued piping installation work on CCL 4 from the CF DI and Chilled Water headers to the RCCS skid.
- A 4" gasket disintegrated and resulted in a substantial leak on the chilled water system. The leak was located outside DI Pump Room #1 (noticed by Paul Holik Friday morning) and resulted in a 1 hour shutdown while the gasket was replaced by CF.
- The strainer on the Chilled Water system leading to RCCS 1 was clogged again Friday morning. The strainer was cleaned and returned to service and CF was notified that the problem had re-occurred. They are currently tracing the issue since this is the first time in a week that the strainer has been filled with what appears to be mud and silt. The iron content continues to be an ongoing issue. Jim Schubert has ordered magnets for installation in the RCCS skid strainers and CF will be ordering them for their system in the CUB.
- DTL 1 was filled with DI and the globe valves on the tunnel were set. I spoke with Johnny Tang on Saturday, we'll be working on Monday to trace the high delta P issue in order to see if there's something we can do to alleviate it.
- Jim Schubert met with Rob Morton and Paul Gibson to determine the requirements for turning the RFQ and 'Big Blue Box' from Chilled Water to DI. A drawing and a parts list has been completed by Jim; we are currently awaiting the decision on where the funding will come from.

#### RING Systems Installation

- Alignment of the HEBT 12Q45 magnets started.
- Alignment of the HEBT Dipole magnets started.
- Installation of the 21Q40 magnet stands started.
- The grouting of the HEBT magnet stands previously installed was dressed out.
- Cable tray installation in the RING continues.
- SCL waveguide (High-beta ME3): is under construction with several pieces already in place.
- Rewelding of Quad Stands: 15 out of 30 are completed. The remaining will be completed on Monday. The first 5 quadrupoles have been placed on these stands - the remaining quads that have been tubes installed (appx. 10) will be placed next week.
- The first 1/2 cell will be on the stand and ready for survey on Tuesday.
- Next week we will start the process of removing HEBT dipoles, stands, and grout, in preparation for the 1" move.
- Scupper in front of HEBT door should be completed by Wednesday.

Final vacuum and cooling system tests for DTL-1 have been completed. All shielding is in place and the shielding configuration drawing has been signed. Conditioning of is expected to begin on Friday afternoon (7-11-03).



DTL-1 Ready for Conditioning



DTL-1 Shielding in Place

DTL-4 has been moved to the FE building. Installation of the cooling manifolds onto the frame will begin next week.

### **Magnet Task**

We spent the week mapping DTL EMD's.

### **Electrical Group**

Last week, the last 140 kV HVCM was completed at Dynapower. The safety system upgrade on DTL-ME1 was completed to include AC power disconnect capability and water shutdown in emergency situations. Careful measurements on DTL-ME1, operating into two klystrons, characterizing the IGBT and primary currents and output voltage ripple were performed at 105 kV and will be logged for future HVCM checkout. SCR bridge upgrades are being performed on all installed units at ORNL. Preparation for operation of the RFTF HVCM at full average power are continuing, and we expect to begin those operations the week of 21Jul03.

Operation of the MEBT choppers at full peak power was performed this week after hipotting last week. A worrisome post pulse reflection is being further investigated by performing TDR measurements of the structures.

We have started the installation process for DTL-ME3 and CCL-ME1 HVCM units. We expect to start installation of SCL-ME1 the week of 21Jul03 after shipment from Dynapower, pending inspection next week. Next week ORNL will support vendor oversight at Dynapower.

CCL1 module all cabling in between klystron building and the tunnel is in place except diagnostic (scheduled for next week)

SCL first row of racks and magnet cabling for MB01 and MB02 done

HEBT corrector magnet and magnet klaxon cabling started Wednesday

Ring SB south west floor plan for magnet power supplies and cable tray placement done

Ring SB south west - duct bank at 9 o'clock cable tray in place, HEBT magnet cable pulls from Ring SB starts next week

Ring tunnel septum magnets and injection bend magnet DC bus fabrication in progress, installation next week

Ring tunnel cable tray is 75% complete, i.e. tray system in the 6 o'clock region is to be completed

## **HPRF**

Waveguide to DTL1 connected, LLRF system ready, HVCM ready, hope to start conditioning today.

First SC transmitter in position, (6-tubes), interconnecting cable installation can now begin along with AC power hookup.

Three-tube transmitter tank ready in the RFTF working on the 2nd 3-tube transmitter tank.

Mike McCarthy & Tom Owens will be back from BNL Monday.

## **LLRF**

### **New Hardware Development**

#### **FCM Rev A**

The current focus of the LLRF team is system integration of the hardware, firmware and software as well preparing for the next revision of the hardware.

Following successful demonstration of field control of a test cavity with FCM #1 at LBNL, the system was shipped to ORNL for high power testing with RFQ. With this shipment the team achieved a major milestone of delivering a prototype system to ORNL in June. Kay Kasemir traveled to ORNL to help with the setup of the EPICS system and the support software. He also carried FCM #2 to ORNL which, following a small change to the motherboard was made operational as well. Following some firmware fixes by Craig Swanson, the two systems have been successfully tested on the bench and are available for testing with RFQ and DTL on the next available opportunity.

We received two additional DFE boards from Suntron and have setup FCM #3 at the LLRF lab at LANL. The system is operational and we have successfully demonstrated field control with a test cavity. FCM #4 will be shortly delivered to LBNL to accomplish the goal of having at least one functioning system at each lab. FCM #5 will be a spare unit at LANL.

Kay Kasemir successfully demonstrated programming the DFE FPGA via the VXI interface. Thus the system may be booted remotely during operation. Due to the size of the "bit file" and the speed of the VXI backplane, the process takes about 10 seconds.



#### FCM Rev B

Work has progressed very well in preparation for producing Rev B of the FCM. All of the modifications for the DFE, VXI and the RFO boards have been communicated to the ECAD group and incorporated in the new board designs. Complete design documents will be available on July 17 and we will have a team meeting on July 18 to review the revisions for correctness and completeness. The boards will go to fabrication and assembly on Monday, July 21. We are placing an order for 5 units with Suntron.

The goal for Rev B is to be a “dry run” for the final FCM production. We are paying extra attention to the details and the quality of the design documentation to assure high degree of board functionality on delivery from manufacturer. Bill of Material has been shipped in advance to Suntron to expedite board production.

The FCM front panel has been also redesigned to assure proper fitting and to correct some mislabeling. The design has been released to fabrication.

#### FCM Production Rev

We are compiling a list of long-lead items, that we may need to procure prior to releasing production contracts, to expedite the final (production) Rev of the FCM.

#### Production for DTL

The production of 2nd generation control chassis for the DTL is ongoing at LBNL. All long-lead items are in hand and fabrication and assembly is in progress. Four chassis for DTL2 and DTL4-6 are due at ORNL in September.

#### Operations

Hengjie and Carl continue to make improvements in the user interface for all of the LLRF control systems. All systems are ready to support testing and beam commissioning of DTL1.

Channel access security was implemented on the High-power Protect Module (HPM) EPICS process variables to prevent unauthorized changes to trip points.

#### Cryo Systems Group

CHL: The charcoal absorber is now being vacuum cycled on a daily basis.  
The three first stage warm compressor motors couplings have been aligned.  
King the mechanical contractor for the purifier piping has started pressure testing.

Tunnel: All the valves have been installed on the transfer line.  
The warm gas piping installation continues.  
We are now starting to level the transfer line into its final position.

RATS: We have started to assemble subassemblies for the “U” tubes.

2K Cold Box: The cold box is scheduled for delivery from JLAB on the 7/28/03.



First installed medium beta cryomodule on June 30

## Beam Diagnostics